

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

Claim 1 (withdrawn): A material for a semiconductor-mounting heat dissipation substrate, the material being a copper-molybdenum rolled composite obtained by infiltrating and filling melted copper in a void or gap between powder particles of a molybdenum powder compact to produce a molybdenum-copper composite and rolling the molybdenum-copper composite, the rolled composite having a coefficient of linear expansion of $8.3 \times 10^{-6}/\text{K}$ or less at 30-800°C in a final rolling direction in which a plate material is rolled.

Claim 2 (withdrawn): A material for a semiconductor-mounting heat dissipation substrate as claimed in claim 1, wherein the rolled composite is a rolled product subjected to primary rolling in one direction at a temperature of 100-300°C and at a working rate of 50% or more and then subjected to secondary rolling as cold rolling in a direction intersecting with the one direction at a working rate of 50% or more, a total working rate being 60% or more, the coefficient of linear expansion in the secondary rolling direction at 30-800°C being $7.2-8.3 \times 10^{-6}/\text{K}$.

Claim 3 (withdrawn): A material for a semiconductor-mounting heat dissipation substrate of a copper-clad type, comprising a copper/copper-molybdenum composite/copper clad material formed by press-bonding copper plates to both surfaces of a rolled composite, the rolled composite being the material for a semiconductor-mounting heat dissipation substrate of claim 1.

Claim 4 (withdrawn): A material for a semiconductor-mounting heat dissipation substrate of a copper-clad type as claimed in claim 3, wherein the copper-molybdenum composite forming an intermediate layer has a coefficient of linear expansion of $8.3 \times 10^{-6}/\text{K}$ or less at a temperature not higher than 400°C by controlling the ratio of copper and molybdenum and a draft rate, the material having a coefficient of linear expansion of $9.0 \times 10^{-6}/\text{K}$ or less at a temperature not higher than 400°C.

Claim 5 (withdrawn): A material for a semiconductor-mounting heat dissipation substrate of a copper-clad type as claimed in claim 3, wherein the copper-molybdenum composite forming an intermediate layer has a coefficient of linear expansion of $8.3 \times 10^{-6}/K$ or less at a temperature of 30-800°C, the material having a coefficient of linear expansion of $9.0 \times 10^{-6}/K$ or less at a temperature of 30-800°C.

Claim 6 (withdrawn): A ceramic package comprising a heat dissipation substrate made of a material for a semiconductor-mounting heat dissipation substrate of a copper-clad type as claimed in claim 5.

Claim 7 (currently amended): A method of producing a material for a semiconductor-mounting heat dissipation substrate, comprising: [the steps of]

press-forming molybdenum powder having an average particle size of $2-5\mu m$ at a pressure of 100-200 MPa to obtain a molybdenum powder compact,

impregnating melted copper into a void between powder particles of the molybdenum powder compact in a non-oxidizing atmosphere at 1200-1300°C to obtain a composite of molybdenum and copper which contains 70-60% [molybdenum] molybdenum in weight ratio, the balance copper, and

rolling the composite at a working rate of at least 60% to produce a rolled composite, the rolled composite having a coefficient of linear expansion of $8.3 \times 10^{-6}/K$ or less at 30-800°C in a final rolling direction.

Claim 8 (currently amended): A method of producing a material for a semiconductor-mounting heat dissipation substrate as claimed in claim 7, [comprising a rolling process in which] wherein said step of rolling comprises the sub-steps of:

primary rolling [is] carried out in one direction at a temperature of 100-300°C and at a working rate of 50% or more, and

secondary rolling [is] carried out as cold rolling in a direction intersecting with the one direction at a working rate of 50% or more, a total working rate being 60% or more, thereby

producing a rolled composite of molybdenum and copper which has a coefficient of linear expansion of $7.2\text{-}8.3 \times 10^{-6}/\text{K}$ at 30-800°C in the secondary rolling direction.

Claim 9 (currently amended): A method of producing a material for a semiconductor-mounting heat dissipation substrate as claimed in claim 7, further comprising: [the step of]

press-bonding copper plates to both surfaces of the rolled composite to obtain a substrate for a semiconductor-mounting heat dissipation substrate [of] having a copper-clad [type].

Claim 10 (currently amended) A method of producing a material for a semiconductor-mounting heat dissipation substrate as claimed in claim 9, [comprising the steps] wherein said step of rolling the copper-molybdenum composite as an intermediate layer is carried out with the ratio of copper and molybdenum and the reduction percentage controlled so that a resultant rolled composite has a coefficient of linear expansion equal to $8.3 \times 10^{-6}/\text{K}$ or less at a temperature not higher than 400°C, and thereafter the step of press-bonding copper on both surfaces of the rolled composite is carried out to obtain a copper-clad rolled composite having a coefficient of linear expansion of $9.0 \times 10^{-6}/\text{K}$ or less at a temperature not higher than 400°C.

Claim 11 (currently amended): A method of producing a material for a semiconductor-mounting heat dissipation substrate as claimed in claim 9, [comprising the steps of obtaining] wherein said step of rolling the copper-molybdenum composite [forming] as an intermediate layer [having] is carried out with the ratio of copper and molybdenum and the reduction percentage controlled so that a resultant rolled composite has a coefficient of linear expansion of $8.3 \times 10^{-6}/\text{K}$ or less at a temperature of 30-800°C [by controlling the ratio of copper and molybdenum and the reduction percentage], and thereafter said step of press bonding copper on both surfaces of the copper-molybdenum composite is carried out to obtain a copper-clad rolled composite having a coefficient of linear expansion of $9.0 \times 10^{-6}/\text{K}$ or less at a temperature of 30-800°C.

Claim 12 (currently amended): [According to this invention, there is also provided a] A method of producing a ceramic package, comprising the steps of:
press-forming molybdenum powder having an average particle size of 2-5 μm at a pressure of 100-200 MPa to obtain a molybdenum powder compact, impregnating melted copper into a void

between powder particles of the molybdenum powder compact in a non-oxidizing atmosphere at 1200-1300°C to obtain a copper-molybdenum composite containing 70-60% [molybdenum] molybdenum in weight ratio, the balance copper, and rolling the composite at a working rate of at least 60% to produce a rolled composite having a coefficient of linear expansion of $8.3 \times 10^{-6}/K$ or less at 30-800°C in a final rolling direction;

press-bonding copper plates to both surfaces of the rolled composite to obtain a copper-clad rolled composite having a coefficient of linear expansion of $9.0 \times 10^{-6}/K$ or less at a temperature of 30-800°C; and

directly brazing the copper-clad rolled composite with ceramic having a [metallize] metal layer affixed to [its] a surface of the ceramic.

Claim 13 (withdrawn): A rolled composite formed by impregnating copper into a void between powder particles of molybdenum powder compact and rolling said powder compact, wherein the coefficient of linear expansion of the rolled composite is defined by the direction of final rolling in the rolling process and is equal to $8.3 \times 10^{-6}/K$ or less in a temperature range of 30-800°C.

Claim 14 (withdrawn): A rolled composite as claimed in claim 13, wherein the coefficient of linear expansion is $7.2-8.3 \times 10^{-6}/K$ in a temperature range of 30-800°C.

REMARKS

Claims 1-14 are all the claims pending in the application. Claims 1-6, 13 and 14 have been cancelled without prejudice or disclaimer as drawn to a non-elected invention. Claims 7-12 have been amended in order to remove minor informalities identified by the Examiner.

Election/Restriction

The Examiner correctly describes the request for election and response by the Applicants. Applicants confirm that they have elected claims 7-12 for examination and have canceled non-elected claims 1-6 , 13 and 14 without prejudice or disclaimer to their filing in a divisional application.

Claim Objections

The Examiner has objected to the claims, specifically claims 7 and 12, because of grammatical and/or spelling errors. The Examiner also has objected to claims 10 and 11 because of perceived improper dependency. These bases for objection have been remedied by Applicants in the present amendment.

Claim Rejections - 35 U.S.C. § 112

The Examiner has rejected claims 7-12 as indefinite under 35 U.S.C. § 112, second paragraph. Applicants respectfully traverse this rejection as being unsupported, in that the bases for rejection merely reflect the Examiner's personal preference for phrasing and grammar, and do not go to the merits of the claimed invention.

Nonetheless, subject to the foregoing traversal, Applicants have amended claims 7-12 in order to state the subject matter that they consider their invention. The manner in which the amended claims address the specific comments of the Examiner (I-VI) are explained subsequently, using the same numbering system:

(I) A temperature of 800°C corresponds to one at which a substrate is soldered or brazed to ceramic substance or the like by silver solders. The substrate is heat-treated around that temperature after being nickel plated. Then it is necessary and important that coefficients of thermal expansion (CTE's) of the substrate and ceramic substance are matched to each other. That is, it is easily understood that the temperature is decided by taking a melting point of the silver solders into consideration from the description in the text at page 1, line 23 to page 2, line 3 of the specification. There the Applicants teach that ---

Specifically, in the case of a ceramic package using alumina as an insulator, the package is assembled by bonding alumina and a heat dissipation substrate by a silver brazing alloy. However, in order that the coefficient of thermal expansion of the composite alloy has a value approximate to that of alumina in a temperature range between normal temperature and about 780°C at which the silver brazing alloy solidified,---.

(II) The substrate material is rolled at a working rate of 50% in a first direction and, thereafter, is rolled at a working rate of 10% or more in a second (perpendicular) direction to the first direction. These roll working are referred to as cross rolling. When the substrate is not cross-rolled at 10% or more, the effect of cross rolling is low, thereby reducing the stability of CTE.

(III) Reduction percentage is a working rate or calking rate when a substrate is clad by another metal. The working rate is a difference of total reduced thickness from an initial thickness. Therefore, reduction percentage does not correspond to the working ratio.

(IV) The substrate has copper-clad layer which is made by press adhering copper plate on the both surfaces, respectively.

(V) As for the Item V, Claim 10 is directed to a substrate having a thermal expansion coefficients $9.0 \times 10^{-6} / \text{K}$ or less at 400°C or less, and made by jointing by the means of “soldering a heat dissipation substrate to a insulator substrate,” as described in the specification at page 4, lines 13 to 24.

Claim 11 claims a substrate having a thermal expansion coefficient $9.0 \times 10^{-6} / \text{K}$ or less at 30 to 800°C or less and made by bonding. Specifically, “the substrate is bonded to the ceramics by high-temperature (about 800°C) brazing material (CuAg eutectic brazing material or the like), as described in the specification at page 5, lines 4 to 11. Therefore, the substrate of Claims 10 is different from Claim 11.

(VI) It is applied when a bonding characteristic is not better with ceramics. The ceramic is subjected to bond a layer like W powder or the like to the substrate.

Applicants respectfully submit that the claim objections and rejections are overcome by the foregoing explanations and amendments to the claims.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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